Claims

1. A Ziegler catalyst for preparing 1-olefin homopolymers and copolymers by polymerization of a 1-olefin of the formula $R^4CH=CH_2$, where R^4 is hydrogen or an alkyl radical having from 1 to 10 carbon atoms, in suspension, in solution or in the gas phase, which catalyst comprises the reaction product of a magnesium alkoxide (component a) with a halogen compound (component b) and an organometallic compound (component c) together with an additional component (d) comprising a compound of the chemical formula

$$M - R_x$$

where M is an element of main group IV of the Periodic Table, R is halogen ~~or an organic radical such as alkyl having from 1 to 10 carbon atoms, oxyalkyl having from 1 to 10 carbon atoms, cycloalkyl having from 4 to 8 carbon atoms in the ring and, if desired, from 1 to 6 substituents R' on the ring, aryl having from 6 to 10 carbon atoms in the aromatic and, if desired, from 1 to 6 substituents R' on the aromatic, where R' is a halogen or an alkyl radical having from 1 to 4 carbon atoms or an OH group or an NO_2 group or an oxyalkyl radical having from 1 to 4 carbon atoms, and x is an integer from 1 to 4.~~

2. A Ziegler catalyst as claimed in claim 1, wherein the radicals R in component (d) are identical and the element of main group IV of the Periodic Table present in component (d) is preferably silicon or germanium.

3. A Ziegler catalyst as claimed in claim 1, wherein the radicals R in component (d) are not identical and radicals R having various possible meanings are combined with one another and the element of main group IV of the Periodic Table present in component (d) is preferably silicon or germanium.

4. A Ziegler catalyst as claimed in one or more of claims 1 to 3, wherein component (a) is a magnesium alkoxide of the formula $Mg(OR^1)(OR^2)$, where

R^1 and R^2 are identical or different and are each an alkyl radical having from 1 to 6 carbon atoms, in particular $Mg(OCH_3)_2$, $Mg(OC_2H_5)_2$, $Mg(OiC_3H_7)_2$, $Mg(OnC_4H_9)_2$, $Mg(OCH_3)(OC_2H_5)$, $Mg(OC_2H_5)(OnC_3H_7)$, or a magnesium alkoxide of the formula $Mg(OR)_nX_m$, where X = halogen, $(SO_4)_{1/2}$, OH, $(CO_3)_{1/2}$, $(PO_4)_{1/3}$ or Cl, R is as defined above for R^1 or R^2 and n + m = 2.

5. A Ziegler catalyst as claimed in one or more of claims 1 to 4, wherein the component (b) present is a transition metal compound such as a Ti compound such as $TiCl_4$ or $Ti(OR)_4$, a Zr compound such as $ZrCl_4$, $Zr(OR)_4$ or $ZrCl_2(OCOC_6H_5)_2$, a V compound such as VCl_4 or $VOCl_3$ or a Cr compound such as CrO_2Cl_2.

6. A Ziegler catalyst as claimed in one or more of claims 1 to 5, wherein the component (d) preferably has a chemical composition in which the radical R is a chlorine or bromine atom or an alkyl radical having from 1 to 6 carbon atoms, preferably from 1 to 4 carbon atoms, an oxyalkyl radical having from 1 to 6 carbon atoms, preferably from 1 to 4 carbon atoms, a cycloalkyl radical having 5 or 6 carbon atoms or a phenyl radical.

7. A Ziegler catalyst as claimed in one or more of claims 1 to 6, wherein the component (c) present is an organometallic compound of a metal of group 1, 2 or 13 of the Periodic Table, preferably an organoaluminum compound, particularly preferably a chlorine-containing organoaluminum compound such as a dialkylaluminum monochloride of the formula $R^3{}_2AlCl$ or an alkylaluminum sesquichloride of the formula $R^3{}_3Al_2Cl_3$, where R^3 is an alkyl radical having from 1 to 16 carbon atoms.

8. A process for preparing a Ziegler catalyst as claimed in one or more of claims 1 to 7, which comprises reacting the magnesium alkoxide of the component (a) with the organometallic compound of the component (b) at a temperature in the range from 20 to 100°C, preferably from 60 to 90°C, in the presence of an inert hydrocarbon while stirring, with from 0.05 to 5 mol of component (b) being used per 1 mol of magnesium alkoxide, preferably from 0.1 to 3.5 mol of

component (b) per 1 mol of magnesium alkoxide, wherein an additional component (d) containing a metal M is added.

9. The process as claimed in claim 8, wherein the component (d) is added at a temperature of from 20 to 120°C, preferably from 60 to 100°C, in the presence of an inert hydrocarbon while stirring, with from 0.05 to 5 mol of component (d) being used per 1 mol of magnesium alkoxide, preferably from 0.1 to 3.5 mol of component (d) per 1 mol of magnesium alkoxide.

10. The process as claimed in claim 8 or 9, wherein the reaction time is from 0.5 to 8 hours, preferably from 2 to 6 hours.

11. The process as claimed in any of claims 8 to 10, wherein the reaction product of component (a), component (b) and component (d) is subsequently reacted with component (c), viz. a chlorine-containing organoaluminum compound.

12. A process for preparing 1-olefin homopolymers and copolymers by polymerization of a 1-olefin of the formula $R^4CH=CH_2$, where R^4 is hydrogen or an alkyl radical having from 1 to 10 carbon atoms, in suspension, in solution or in the gas phase in the presence of a catalyst as claimed in one or more of claims 1 to 7, where the catalyst is combined with a cocatalyst either in a stirred vessel at a temperature in the range from -30 to 150°C, preferably from -10 to 120°C, prior to the polymerization or directly in the polymerization vessel at a temperature in the range from 20 to 200°C and the polymerization is carried out in solution, in suspension or in the gas phase, continuously or batchwise, in one or more stages at a temperature in the range from 20 to 200°C, preferably from 50 to 150°C, and a pressure in the range from 0.5 to 50 bar, preferably from 1.5 to 30 bar.

13. The process as claimed in claim 12, wherein the addition of the cocatalyst is carried out in two steps, with the catalyst being preactivated with a first part of cocatalyst at a temperature in the range from -30 to 150°C prior to the polymerization reaction and the further addition of a further part of the same

cocatalyst or another cocatalyst being carried out in the polymerization reactor at a temperature of from 20 to 200°C.

14. The process as claimed in claim 12 or 13, wherein the catalyst is introduced into the polymerization reaction in a prepolymerized state.

15. The process as claimed in any of claims 12 to 14, wherein ethylene, propylene, 1-butene, 1-hexene, 4-methyl-1-pentene or 1-octene, particularly preferably ethylene alone or in a mixture of at least 50% by weight of ethylene and not more than 50% by weight of another 1-olefin of the above formula, is polymerized and the molar mass of the polymer is preferably regulated by means of hydrogen.

16. The process as claimed in any of claims 12 to 15 carried out in suspension or solution, wherein the catalyst is used in a concentration, based on transition metal, of from 0.0001 to 1 mmol, preferably from 0.001 to 0.5 mmol, of transition metal per dm^3 of dispersion medium and the polymerization is carried out in an inert dispersion medium selected from the group consisting of aliphatic and cycloaliphatic hydrocarbons such as butane, pentane, hexane, heptane, isooctane, cyclohexane, methylcyclohexane, and petroleum fractions and hydrogenated diesel oil fractions which have carefully been freed of oxygen, sulfur compounds and moisture.

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